THE ROLE OF CUE FAMILIARIZATION IN THE DISCRIMINATION PERFORMANCE OF RETARDATES, PRIMARY STUDENTS AND COLLEGE STUDENTS

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THE ROLE OF CUE FAMILIARIZATION IN THE DISCRIMINATION PERFORMANCE OF RETARDATES, PRIMARY STUDENTS AND COLLEGE STUDENTS[1]

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Considerable recent research has compared various discrimination transfer paradigms because of their relevance to chaining theories of discrimination learning. These theories have in common a two-link interpretation of the discrimination learning process. The first link is that of attending to (Zeaman & House, 1963; Mackintosh, 1965), verbalizing (Kendler & Kendler, 1962) or perceptually isolating (Tighe, 1965) the class or dimension to which the discriminanda belong; the second link is performing the instrumental choice response required by the task. One phenomenon that apparently requires a two-link theory is the overtraining reversal effect, the common finding that overtraining paradoxically facilitates the reversal of a discrimination habit. If discrimination required only instrumental learning, more pre-reversal training should make the reversal more difficult. The paradox is resolved by positing that overtraining has its main effect on the first link of the response chain. With greater overtraining the subject would have a greater disposition to attend to the dimension that had been relevant before the reversal. The facilitation that results from overtraining of the dimensional response is presumably sufficient to overcome the impairment that results from overtraining the instrumental response.

This interpretation of the overtraining reversal effect would require also an overtraining facilitation effect for the ID shift. However, a recent comprehensive review by Wolff (1967) reported only two

of five possible cases in which such facilitation was observed. In both of these (Eimas, 1966; Uhl, 1966) the overtraining facilitated the extra-dimensional shift as well as the intradimensional shift, suggesting that some sort of warm-up mechanism and not the dimensional response was responsible for the facilitation. The most likely explanation for the apparently greater facilitation of the reversal than of the intradimensional shift is that some or all of the overtraining reversal facilitation is transferred through the familiarization of specific cues used. Such facilitation would not be expected in the intradimensional shift because the overtraining (familiarizing) occurs on cues that have been replaced for the shift problem.

There is also evidence to suggest that the influence of overtraining on discrimination shifts might vary as a function of intelligence. Heal (1966) found that overtraining facilitated normals' discrimination transfer performance relative to retardates'. Such a finding might be attributed to an encoding deficit in the retardate (Belmont & Butterfield, in press) or to their presumably greater rigidity (Zigler & Butterfield, 1966) or inhibition deficit (Heal & Johnson, in press). It would follow that the facilitation of discrimination reversal by overtraining would be much less for retardates than for nonretardates.

In brief, then, the present study examined the role of cue familiarization in the discrimination transfer performance of populations who differed in intelligence. It was expected that overtraining would facilitate the reversal but not the intradimensional shift performance of non-retardates, but would, if anything, impair the shift performance of retardates.

or a loud buzzer (incorrect). The sequencing of stimuli and rewards, and shifting from Stage 1 to Stage 2 were programmed electronically using relay and switching circuits. The intertrial and interproblem intervals were a constant two seconds.

Experimental Conditions

Within each population a 2x2x2 design had the following factors: Stage 1 Training Criterion (5 or 20 consecutive correct), Shift (Intradimensional shift versus Reversal) and Cue Sets (A or B). The transfer paradigms are shown in Table 1. For both the shift problems, difficult-to-discriminate form cues were relevant and easy-to-discriminate color cues were variable irrelevant (each color cue was correlated with the correct form cue on an unsystematic half of the trials). Both shift problems had two stages. For the Reversal, the same cues were used in Stage 2 as had been used in Stage 1, but the values were reversed, requiring a subject to choose his Stage 1 negative cue. For the Intradimensional shift, all Stage 1 cues were replaced in Stage 2, so that the subject had to learn a new problem on the same dimension. A set of cues consisted of two forms and two colors. Cue sets A and B were counterbalanced so that each set of four cues was used equally often for Stage 1 and Stage 2 of both the Intradimensional shift and the Reversal problem.

Procedure

The three populations were run at separate times during 1967 and 1968. One female experimenter tested the retardates in the fall and winter, and the primary school children in the next summer; another ran the college students in the spring. Subjects were brought to the laboratory individually.

Table 1 about here

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Each of eight consecutive Stage 1 learners was assigned to one of the eight conditions at random without replacement. Just prior to being tested each S was told in words that were appropriate for his population that he was supposed to figure out how to ring the door-chime on every trial and not to buzz the buzzer on any. The experimenter then administered the test from a separate room and observed the subject through a one-way window. In order to avoid excessive loss of subjects, special training procedures were implemented in Stage 1. Following the first error after the 24th trial in Stage 1, the irrelevant color cues were eliminated, leaving only the relevant form cues. Following the first error after the 24th trial of this special training, E entered the experimental room and said, "This is a hard problem, isn't it, ____________? Let me help you a little bit." (At this point E turned on the projectors using a hidden switch.) "Do the pictures look alike to you?" (At this point E showed S how they differed.) "Okay, now you try it."

A subject was dropped after his first error following his second set of verbal instructions. If he reached criterion of ten consecutive correct during special training, he was again administered Stage 1. Following his first error after the 24th trial of his second attempt at Stage 1, he was again given special training. The procedure for this second attempt at special training was exactly the same as that of the first. After he reached criterion on this second attempt, he was again administered Stage 1. A subject was eliminated following the first error after the 24th trial of this third attempt at Stage 1.

When he reached criterion (either 5 or 20 consecutive correct, depending upon his condition) a subject was shifted immediately and without

warning to Stage 2. Stage 2 continued to a criterion of ten consecutive correct trials or to a maximum of 100 trials. Following the session a retardate or primary student was given a nickel. About half the college students were given course credit for participation; the remainder were volunteers who participated without compensation.

Results

Separate analyses of variance were done for total trials, total errors, and total correct for Stage 1 and Stage 2 for all three populations (eighteen analyses), and also for the difference between Stage 1 and Stage 2 errors for all three populations.

For all analyses, there were 40 college students, 40 retardates, and 56 primary children assigned in equal numbers to the eight cells of the experimental design. To facilitate communication, the results will be presented in detail only for total trials. Other data will be presented only to the extent that they qualify conclusions based upon these total trials data. Preliminary analyses indicated that cue sets and their interactions were not significant sources of variation in Stage 2 for any analysis. Therefore, the data were collapsed over cue sets for the analyses reported below.

Stage 1

Within each population there were very few differences associated with assignment to treatments. When the 15 overtraining trials were subtracted from the Criterion-20 conditions, the only significant effects were five that involved cue sets or interactions with cue sets in one or another of the four dependent variables that involved Stage 1 data. Between populations there was substantial difference. The mean total trials to the last error was 13.72 for the college students, 45.5 for the retardates,

and 50.36 for the primary children. The pairwise comparisons using the error mean squares from the analyses of variance to derive error terms, showed college students to differ significantly from retardates, $F(1,72) = 30.05$, $p < .01$, and from the primary children, $F(1,88) = 47.04$, $p < .01$; but the retardates did not differ from the primary children, $F(1,88) = .58$.

Stage 2

The mean total trials for each of the four experimental conditions for each of the three populations is shown in Figure 1. Analyses of variance (Table 2) supported the following statements about these data. (1) College students differed from primary students, $F(1,88) = 16.34$, $p < .01$, who in turn differed from retardates, $F(1,88) = 19.29$, $p < .01$.

Table 2 about here

Figure 1 about here

---

(2) While college students found this task quite easy, they took significantly longer after the Stage 1 criterion of 5 consecutive correct on the Reversal problem than they did under the other three Shift x Training Criterion conditions, Shift x Training Criterion interaction, $F(1,39) = 4.30$, $p < .05$. (3) Retardates found the ID shift harder than the Reversal, $F(1,36) = 6.03$, $p < .05$, as did the primary children, $F(1,52) = 5.05$, $p < .05$. (4) Overall performance by the primary students tended to be facilitated by overtraining, $F(1,52) = 3.50$, $p < .064$.

This last finding suggested a Populations by Training Criterion interaction, which was assessed in two ways. First a five-way analysis of variance was done using only a randomly chosen five primary students

in each cell to equalize numbers. This analysis showed primary students to be superior performers, F (1, 64)= 16.34, p < .01, and the Reversal to be easier than the Intradimensional Shift, F (1,64)= 8.21, p < .01. The critical test, F-ratio for the Populations by Training Criterion interaction, was 1.058. Second, the data from all 49 retardates and 61 primary students who learned Stage 1 were dichotomized into Stage-2 learners and non-learners for a series of one-tailed Fisher exact tests. These tests showed that after overtraining there were proportionately more (p .01) Stage-2 learners among the primary students (27/31) than the retardates (9/21). On the other hand, without overtraining there were not proportionately more Stage-2 learners among the primary students (22/30) than among retardates (17/28).

Furthermore, within the Reversal condition significantly more primary students (16/16) than retardates (6/10) learned Stage 2 after overtraining (p < .014). Again, without overtraining the proportion of primary student Stage 2 learners (13/15) did not differ significantly from that of the retardates (9/12).

<u>Correlations of Stage 2 Trials and Several Predictors</u>

Near-comparable conditions in Stage 1 made it feasible to do analyses of covariance within each population. However, these added little to the information provided by the other analyses, since Stage 1 errors did not reliably predict Stage 2 trials. The correlations between total Stage 1 errors and total Stage 2 trials were .141 for college students, .000 for retardates, and .000 for primary students respectively. Furthermore, pooled within-conditions correlations of IQ and Stage 2 trials were -.253 for retardates and -.105 for primary students respectively. The pooled within-conditions correlation of MA and Stage 2 trials was

-.286 for primary students.

Discussion

Implications for Theories of Discrimination Learning

The major finding of the present study was the greater ease of learning an Intradimensional than a Reversal shift for retardates and primary students using these difficult-to-discriminate cues. Most clearly straightforward interpretation of the chaining theories of the Kendlers (1962), Zeaman and House (1963) and Mackintosh (1965) must be modified in the light of these data. In simplest terms these theories predict positive transfer for a transfer task that requires use of the same dimension or class of stimuli as a pre-transfer task and negative transfer for a task that requires the subject to reverse a prior habit. The usual superiority of the Intradimensional shift over the Reversal shift supports the hypothesis that the tasks have similar (positive) dimensional transfer, but that the Reversal task is associated with greater negative instrumental transfer. The present finding that the ID shift is harder than a Reversal is at odds with these prior results and with the theories that predict them.

The cognitive process associated with such transfer is probably, as stated above, that of familiarization of cues. This process is seen as being directly analogous to familiarity or meaningfulness in verbal learning and is considered to be the same basic discrimination process referred to in the theoretical discussion by Tighe and Tighe (1966).

There is at least one alternative explanation for the present shift effect. The two form problems were quite dissimilar in nature. In one case, S had to distinguish between two orientations of a +; in the other

he had to distinguish between two circle-square patterns. Perhaps these two problems were, in fact, on different dimensions. However, this alternative is difficult to reconcile with the tendency for the Intradimensional shift to be easier after overtraining for both primary students and retardates. Two-link theory would predict that overtraining would impair Stage-2 performance if the shift were indeed extradimensional.

Populations by Treatments Interactions

Several interesting, if tenuous, speculations are prompted by an examination of the differential effects of treatments for different populations. First, it seems that the developmentally advanced college students found the Reversal, especially with minimal training, to be more difficult than the Intradimensional shift. This contrasts with the finding reported above for the retardates and primary students, who found the Intradimensional shift to be more difficult. While the college students' data must be interpreted with caution because of the severe floor effect, it appears that they behaved as traditional chaining theories of discrimination learning would have them behave. That is, they showed the decrement in Reversal that these theories would predict for the instrumental link in the two-link chain. The facilitation expected from familiarity of stimulus materials in this Reversal condition was apparently not sufficient to overcome this negative transfer for these subjects.

The non-college subjects, although they found the Reversal to be easier than the Intradimensional shift, failed to show the expected facilitation of Reversal by overtraining. There was, if anything, less facilitation of the Reversal by overtraining than there was of the

intradimensional shift. The tentative conclusion to be drawn from these results is that overtraining in the discrimination transfer situation has its major effect on the dimensional link of the two-link chain, and has little influence on the familiarity of cues. Once two cues are responded to differentially, additional training does not seem to influence the effectiveness with which they are used in subsequent situations.

Finally, there was some evidence to suggest that overtraining, especially under the Reversal condition, facilitated transfer for the primary students relative to that of the retardates. This result is most tenuous, but is consistent with the prior finding by Heal (1966) that overtraining facilitated a within-dimension shift for kindergartners but did not influence the performance of institutionalized retardates on the same task. This interaction is presumably associated with an inhibition deficit on the part of the retardate. Other things being equal, the retardate seems to have greater difficulty abandoning a well-learned habit than does the non-retardate (Heal & Johnson, in press).

Conclusion

There seems to be unequivocal evidence for the presence of a process in discrimination learning that is overlooked by most of the current theoretical positions. Only Gibson (Tighe & Tighe, 1966) has noted the theoretical importance of the discrimination process, *per se*, for the solution of a discrimination problem. Furthermore, the current data suggest that a discrimination, once made, is fairly complete and does not benefit greatly from further training. The implication of this suggestion for more practical learning situations is that time devoted to learning discriminations *per se* should be minimized and time devoted to learning cue classes should be maximized for most efficient learning.

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Footnotes

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[2]Now at Memphis State University, Memphis, Tennessee.

Table 1.

Transfer Paradigms

	Cue Set A				Cue Set B			
	ID		R		ID		R	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
Stage 1	H3	G4	F1	E2	F1	E2	H3	G4
	H4	G3	F2	E1	F2	E1	H4	G3
		(+)	(-)			(+)	(-)	
Stage 2		E1	F2			G3	H4	
		E2	F1			G4	H3	

Note: Cues were projected from the rear onto 3" by 4" screens. Colors filled the entire screen.

1 = blue

2 = green

3 = grey

4 = gold

Symmetrical white forms, superimposed on the colors, measured 2" on a side and were either solid (ubiquitously white) or outlined using a half-inch strip.

E = outlined circle superimposed on a solid square

F = outlined square superimposed on a solid circle

G = + superimposed on an outlined circle

H = x superimposed on an outlined circle

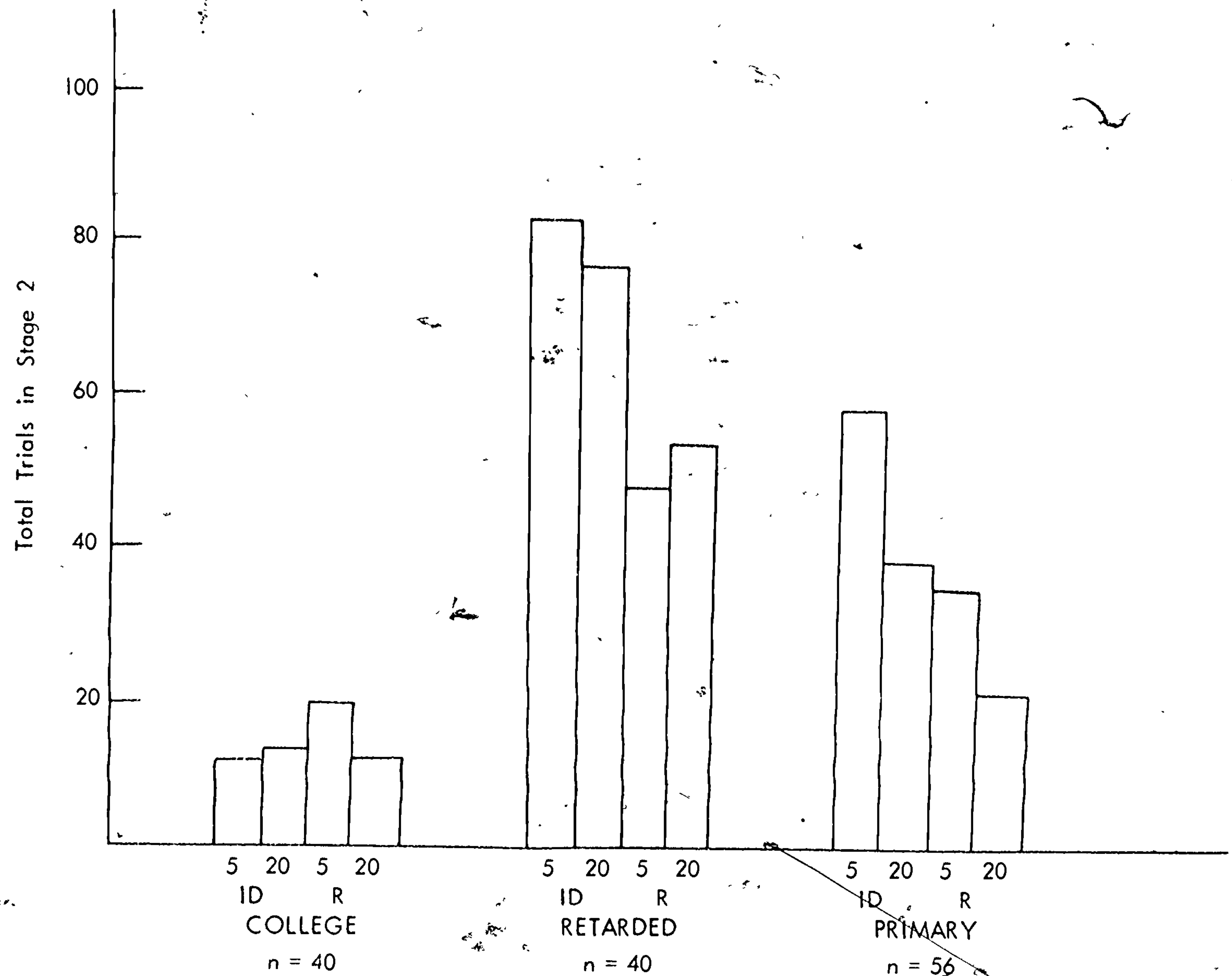
Table 2

Analyses of Variance (Total Stage-2 Trials)

Source	College				Retarded				Primary			
	df	MS	F	p	df	MS	F	p	df	MS	F	p
ID versus R	1	144.40	3.69	.060	1	8151.02	6.03	.018	1	5863.02	5.05	.027
5 versus 20 Criterion	1	136.90	3.50	.066	1	.22			1	4063.02	3.50	.064
Shift X Criterion	1	168.10	4.30	.043	1	378.22			1	147.88		
SBS/AB	36	39.13			36	1351.29			52	1161.92		
Total	39	47.64			39	1466.05			55	1281.70		

Figure Captions

Figure 1. Total Trials to Learn Stage 2 for College Students, Retardates, and Primary Children on either a Reversal or an Intradimensional Shift after a Stage-1 Criterion of either 5 or 20.


Total Trials in Stage 2
100
80
60
40
20
5 20 5 20
ID R
COLLEGE
n = 40
5 20 5 20
ID R
RETARDED
n = 40
5 20 5 20
ID R
PRIMARY
n = 56